15-110 Hw4 - Programming Portion

Each of these problems should be solved in the starter file available on the course website. Submit your code to the Gradescope assignment Hw4 - Programming for autograding.

All programming problems may also be checked by running the starter file, which calls the function `testAll()` to run test cases on all programs.

#1 - `findParents(t, name)` - 15pts

Write the function `findParents(t, name)` which takes a genealogical family tree in the form of a binary tree (as discussed in class) and a string, the name of a person. If the person exists in the tree, the function returns a list containing their parents.

You'll need to use if statements to separate the four possible arrangements of parents. Return an empty list if the parents are unknown, a singleton list in the two cases where only one parent is known, and a two-element list if both parents are known. If the person does not exist in the tree, the function returns `None`. You are guaranteed that every name in the tree only shows up once (to avoid conflicting information).

For example, consider the following family tree (as shown in the course slides):

```
t = { "contents" : "Arya",
      "left"  : { "contents" : "Ned",
                  "left"  : { "contents" : "Rickard",
                              "left"  : None, "right" : None },
                  "right" : { "contents" : "Lyarra",
                              "left"  : None, "right" : None } },
      "right" : { "contents" : "Catelyn",
                  "left"  : { "contents" : "Hoster",
                              "left"  : None, "right" : None },
                  "right" : { "contents" : "Minisa",
                              "left"  : None, "right" : None } } }
```

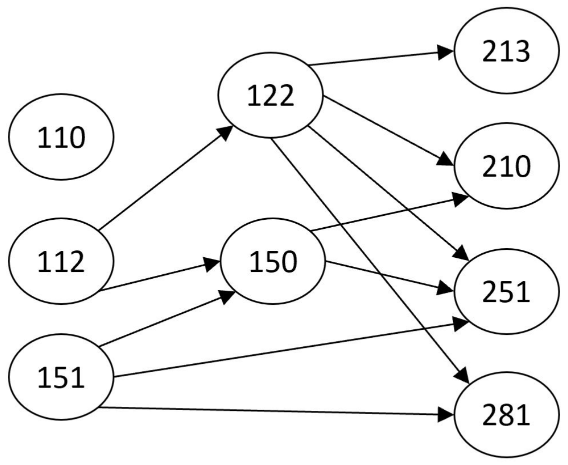
If we called `findParents(t, "Ned")`, the function would return the list `["Rickard", "Lyarra"]`. If we called `findParents(t, "Rickard")`, the function would return `[ ]`. If we called `findParents(t, "Jon")`, the function would return `None` because `"Jon"` is not in the tree.

Hint 1: treat this like a recursive search problem (in fact, you might want to reference tree linear search and binary search if you get stuck). You'll need to make **two** base cases - one for when you find the person, one for when you reach a leaf or an empty tree. For this problem, it may be easier to set up the base case as an empty tree.

Hint 2: unlike recursive binary search, you need to check **both** branches of the tree to see if the person occurs in either branch. How can you combine their results? If one of the branches gives you a list, you've found the parents - return them immediately. If you get `None`, try again on the other branch. If *both* branches return `None`, then the name was not found and you should return `None`.

#2 - getPrereqs - 10pts

College course prerequisites are notoriously complicated. However, we can make them a little easier to understand by representing the course dependency system as a **directed graph**, where the nodes are courses and an edge leads from course A to course B if A is a prerequisite of B. For example, the core Computer Science courses (almost) produce the following prereq graph:



Which would be represented in code as:

```
g = { "110" : [],
      "112" : ["122", "150"],
      "122" : ["213", "210", "251", "281"],
      "151" : ["150", "251", "281"],
      "150" : ["210", "251"],
      "213" : [],
      "210" : [],
      "251" : [],
      "281" : [] }
```

Write the function `getPrereqs(g, course)` that takes a directed graph (in our adjacency list dictionary format, without weights) and a string (a course name) and returns a list of all the immediate prerequisites of the given course. If we called `getPrereqs` on our graph above and `"210"`, for example, the function should return `["122", "150"]`.

Hint: you can't just return the neighbors of the course, because the edges are going in the opposite direction! Instead, iterate over all the nodes to find those that have the course as a neighbor. Construct a new list out of these nodes as the result.